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EDITORIAL.

Agriculture in Trengganu.

The State of Trengganu, although the fourth largest of States in the Malay Peninsula, is probably the least known. Its geographical position has, no doubt, been partly responsible for the fact that development has proceeded at a much slower rate than it has in States more favourably situated. It contains, however, a very considerable population of Malays, and undoubtedly possesses great possibilities of development.

At the invitation of the State, Mr. J. A. Craig, Principal Agricultural Officer in the neighbouring State of Kelantan, visited Trengganu to report on the position of agriculture in that area and to make recommendations regarding the improvements possible.

The visit was made in November 1933, and his report and recommendations presented to the Government of Trengganu which is giving its consideration to the proposals outlined by Mr. Craig. Until such proposals have been accepted as the policy of that Government, publication would be premature. The descriptive portions of the Report, however, are of general interest, in view of which, we have the permission of the Trengganu Government to publish it in this Journal.

Rat Control in Krian.

The widespread damage by rats to standing crops of padi has been a subject of great concern to administrative and agricultural officers for many years past.

In the Krian irrigation area, with its wide stretches of padi land, the situation became so acute some years ago that it was necessary to organise a campaign to reduce this pest.

Concerted action by the padi-growers themselves was almost out of the question at that time. There was little or no cohesion amongst them, and the matter was of such urgency that time could not be wasted in educating them, and bringing them to a state of mind when they could launch a campaign of destruction with any reasonable expectation of success.

Consequently, the Government undertook systematic work of destruction, resulting in a considerable measure of success. Gradually, the position has changed. The rats are still present and so long as padi is grown, a ceaseless

war must be waged to keep their numbers down. But demonstrations, lectures and perhaps a fuller realisation of the danger, have resulted in a more enlightened attitude amongst the padi-growers and, in particular, amongst the headmen.

A new phase in this work has, therefore, come into existence in which the onus of first responsibility for the work has been shifted from the shoulders of the higher authorities, who hitherto had been responsible for the campaign, to the shoulders of the local headmen. In an article in this number on "Rat Control in Krian" an account is given of the present methods of control and of the measure of success so far attained.

While we repeat that ceaseless vigilance is necessary, in consequence of which supervision by this Department and by the administrative officers is still necessary, the measure of success attained is most promising and the amount of work done by the local headmen worthy of great praise.

Marketing of Eggs.

Attention has been drawn from time to time in the pages of this journal and in the Annual Reports of this Department, to the very large importation into Malaya of poultry and eggs. These imports, of course, represent only a portion of the total local consumption, for in many districts of Malaya systematic collection of poultry and eggs is made by Chinese dealers, who forward the produce to the larger markets.

It is desirable that the local production and marketing of poultry and eggs should be encouraged, and it is thought that the difficulties that are encountered are not insuperable. The Department of Agriculture is at present actively engaged in research work on the improvement of the local stock, while an officer of wide local experience in poultry husbandry has been engaged to instruct and encourage the small-holder in the breeding and care of poultry.

Scientific poultry-rearing in Malaya is as yet in its infancy. We seek knowledge on almost every aspect of the problem, in particular on diseases, stock suitable for the country and on correct and economic feeding.

There remains, however, the ever-present problem of marketing. To stimulate interest in poultry keeping we must be able to indicate marketing channels. It is a subject, therefore, that may be persued at once and need not wait for results of research work in other directions. In fact, the existence of organised marketing channels, such as may be provided by recognised co-operative societies, may be, and undoubtedly will be, used as a medium for introducing any improvements which become established.

It will be realised therefore, that constructive work with the object of increasing the local production of poultry and eggs, needs not only the collaboration of the Departments of Agriculture and Veterinary Science, but close touch with the Co-operative Societies Department. We would remark, in passing, that such collaboration exists; the Departments concerned systematically interchange reports on the lines upon which they are working and of the progress made,

while an Inter-Departmental Marketing Committee, composed of representatives of these Departments, meets regularly for the purpose of discussing problems of common interest in this connexion.

It may be thought that we have digressed from the title of this editorial, *viz.* "The Marketing of Eggs", but it was our object to indicate the reason why articles such as that published in this number on "The Co-operative Marketing of Eggs in Malaya" is of interest, not only on account of the valuable work of organisation which it describes, but also for the potential uses to which such societies may be put in the furtherance of the objects which the different departments approach—each from its own angle.

The four Societies at present actively engaged in the marketing of eggs are the pioneers of what, we hope, may grow into an important organisation. The Societies deserve the support of the public which we trust will be forthcoming.

Fish Production in Krian.

In previous numbers of this journal* accounts were given of the methods recommended for fish-rearing in Malaya. Considerable publicity was given to these articles. They were translated into the Malay and Chinese languages for publication in the vernacular journals of this Department and were reprinted in several vernacular newspapers in Malaya.

As a result of this publicity, and of further work by the Fisheries Department and by the Field Branch of the Department of Agriculture, carp-rearing has increased in the country.

In the present number of this journal we publish an article on "Fish Production in the Krian Irrigation Area" which recounts the varieties of fish favoured in that locality, and gives additional information concerning the yield of fish obtained and of its value.

One cannot but be struck by the very large yields that can be obtained from quite a small pond and of the value of carp-rearing as a subsidiary industry to other forms of agriculture—padi planting in particular.

In many districts where flesh foods are scarce and form but a small item in the diet of the poorer native, fish is of particular value; but away from the seaboard and rivers, it is generally expensive. The encouragement of fish-rearing in such localities appears indicated. With lack of transport facilities in many country districts, the establishment of numerous fish ponds seems desirable. This might reduce the amount of imported dried fish consumed in Malaya, a result which would be of benefit to the country and to the health of the individual.

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* Rearing of Carp in Ponds, *Malayan Agricultural Journal*, Vol. XIX No. 8.
Transport of Carp Fry from China, *Malayan Agricultural Journal*, Vol. XIX No. 10.

Original Articles.

RAT CONTROL IN KRIAN, PERAK

BY

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Introductory.

An indication of the extent to which rats are capable of damaging the Krian padi is afforded in an article by H. W. Jack, entitled "Destruction of Rats"* which states that at least six per cent., or about one million gantangs of the crop, in the Krian District of Perak was at that time destroyed by the pest.

In order to reduce this extensive loss, an organised campaign was instituted by the Department of Agriculture, and launched in November 1924,† over a selected area of some 30,000 acres comprising some of the highest-yielding rice fields in Krian.

Original Scheme.

Control Measures.

Initial control measures were based upon a Government subsidy for destruction, a monetary reward of one cent per tail being paid upon presentation at definite collecting and paying centres. Poison baits and traps were issued free, and endeavours were made to popularise various forms of organised hunting.

The results obtained from this campaign were considered to be sufficiently satisfactory to warrant an extension to cover the whole of the Krian District. The extended campaign was commenced in May 1925,‡ one European Officer, with five Malay Assistants being made responsible for the organisation.

The result of the campaign under the caudal system appears to have been satisfactory up to the end of 1929, in so far as no extensive damage to the standing crop was sustained. During the 1930-31 season, however, despite a substantial increase in rats slaughtered, the crop was severely damaged over an aggregate area of some five hundred acres, slighter damage occurring over a much larger area.

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* *Agricultural Bulletin of the F.M.S.* Vol. IX p. 271—276.

† Progress Report on a Campaign against Rats in Krian District, November 15th, 1924—March 31st, 1925. *Malayan Agricultural Journal,* Vol. XIII (1925) p. 168.

‡ Report on the Rat Campaign in Krian between the period May 15th, and end of August 1925. *Malayan Agricultural Journal,* Vol. XIII (1925) p. 364.

Tails accounted for up to the end of 1930 are given hereunder :—

Year		Tails paid for
1925	...	661,794
1926	...	673,102
1927	...	824,791
1928	...	914,644
1929	...	623,712
1930	...	1,791,790

Conclusions.

Experience gained over the period of subsidised destruction indicated the necessity for complete re-organisation of the system, since it was realised that a considerable expenditure was not providing an adequate measure of protection of the standing padi crop against damage by rats. One reason for this was believed to be that there was no great enthusiasm among the actual padi producers to undertake the capture of rats in order to gain the reward. Much of the money disbursed in rewards was collected by Tamil labourers and often for rats captured outside the padi-growing areas. A system on a re-organised basis was planned, and put into effect during 1931.

Modified Scheme.

It is unnecessary to indicate here the many disadvantages that were discovered to be associated with a system that rewarded the cultivators for undertaking the service of protecting their own interests, but it was decided that, in any modified scheme, the payment for tails must cease.

The District of Krian is subdivided into eight "mukims"; these again are subdivided into seventy-one smaller units of area, each under the control of a head-man styled *Ketua Parit*. It was suggested by Mr. J. D. M. Smith, then District Officer, Krian, that the *Ketua Parit* area should be the unit on which a new policy might be based, each *Ketua Parit* being responsible for the active co-operation of cultivators within his area. In return for the added responsibility, the *Ketua Parit,* in whose territory control measures had been efficiently maintained throughout the season, might be remunerated by a small cash bonus consistent with the results achieved.

Organisation.

The original campaign was controlled by the Senior Agricultural Officer in the State, stationed at Taiping, through a European Rat Destruction Officer and nine temporary Malay Assistants, each assistant being in charge of a definite number of *Ketua Parit* areas, in which *mukim* boundaries were observed in order to induce some measure of competition. Responsibility for rat destruction was transferred directly to the cultivator, the departmental organisation being concerned with the supply and distribution of traps and poison, and the supervision and demonstration of their effective use, together with extensive propaganda and instruction work throughout the District.

Control Measures.

Poison.

Sodium Arsenite. This poison has been found to yield satisfactory results, and after careful experimentation, the following formula was evolved for use and is considered to be effective and economical :—

Rice polishings	...	46 ozs.
Tapioca flour	...	45 „
Tallow	...	4 „
Palm Oil	...	47 „
Water	...	24 „
Salt	...	3 „
Sodium arsenite	...	18 „

These quantities were found to give a volume which could conveniently be mixed by one man in a small "Shanghai" jar, and which produced a mass of good consistency with a pleasant odour, machined easily, balled well and dried in a short period. A rapid method of balling has been evolved by passing the mass through an ordinary culinary mincing machine fitted with a plate containing a number of small round holes, about one quarter inch diameter, through which the material is delivered.

The cost per ton of the mixture, excluding making, packing and supervision is $98.83 (Straits Settlements currency). One ton of the mixture is sufficient for some 2,240,000 poison balls. These balls are readily taken by the rats and prove very effective. The flavour and aroma can be changed occasionally with advantage by substituting a small quantity of dried fish or prawns, for a similar weight of polishings and tapioca flour.

With a large-sized machine, four men could in a week, make, dry, and pack up to one ton of poison balls.

The baits were laid at frequent intervals along *batas* and bunds, especially at or near the entrance to holes. Roadside drains, village boundaries and waste land were treated in a similar manner, except that near any habitation the bait was usually placed in a bamboo to prevent it being taken by domestic animals. It is considered that rats are attracted by freshly turned ground, and a little scraping of the soil near the bait was advocated.

Cultivators prefer to mix the prepared poison baits with tapioca roots, fish or coconut, to render them more attractive. To allay suspicion, the baits are usually concealed beneath a small heap of padi husk, and it is claimed that, by employing this method, baits are more readily taken.

Barium carbonate. This material can be handled and used with a greater measure of safety than sodium arsenite, and is very effective in destroying rats. Baits prepared in accordance with the following formula have been used with success in Krian :—

Rice polishings	...	48 ozs.
Tapioca flour	...	48 „
Barium carbonate	...	64 „
Tallow	...	4 „
Palm oil	...	48 „
Water	...	48 „

Freshly prepared baits should immediately be placed on dry racks, and dried in the sun before use or storage, to prevent possible mould growth and consequent deterioration.

The cost of the ingredients for the preparation of one ton of poison balls, is approximately $80 (Straits). The method of manufacture is similar to that used in connexion with sodium arsenite.

Certain insects, more especially cicadas, grass-hoppers and dragon flies, are particularly relished by rats, and barium carbonate, being odourless and tasteless, can be used with almost certain and deadly effect by placing about two grains of the powder in the body cavity of any of these insects. Small doses of barium carbonate are not fatal to human beings or domestic animals, and it can, therefore, be used with relative safety in and near dwellings; safety precautions, however, should always be taken.

A useful method of capturing dragon flies is to smear small twigs with the latex of the jack fruit tree, and place them at the edges of water holes and streams frequented by the insects.

In preparing baits it is always advisable to smear the hands with an essential oil e.g. oil of aniseed, to mask the human smell.

It is interesting to note that poison baits, for which no general success was claimed under the initial scheme, enjoyed an almost immediate popularity. During the period June—December 1931, 18,022 pounds of poison balls were distributed; this represents approximately 18,,022,000 poison baits, each containing 0.696 grains of sodium arsenite. It has been suggested that under the caudal payment system, poison was not extensively used because rats poisoned by one cultivator would probably go to another owner's land to die.

The distribution of poison is well organised. The *Ketua* of a unit area is supplied direct from the manufactory: in addition, the Malay Assistants are responsible for distribution in native homesteads, and also have a poison stall at all village fairs where material is issued to those requiring it.

Traps.

Steel Traps. Early observations indicated that good results could be obtained by using a cheap imported type of steel break-back trap, which could be obtained in cases of twenty-five dozen, at eighty-five cents per dozen. Under field conditions, these traps require constant care and attention to prevent them from becoming rusty and consequently going out of order; while in addition, they need daily visits for re-setting and baiting. They are, however, largely used on Padi Test Plots and Stations in Perak, and give very satisfactory results.

As with poison, the human smell should be masked when handling traps, and this can be done economically and effectively by smearing the hands with mud, or holding them over the smoke of a small grass fire.

A large variety of baits may be employed, the most effective being padi, dried fish or prawns, tapioca root, coconut meat—preferably heated over a fire before use—and the insects mentioned in connexion with barium carbonate. One disadvantage of using padi as a bait is that the trap is often sprung by birds.

During 1931, 23,860 steel traps were distributed to cultivators in Krian, but it was observed that these were not used to nearly the same extent as previously, and it can only be presumed that this was due to the trouble of baiting, resetting and maintenance, coupled with the cessation of tail-money. The free supply of these traps has now been discontinued, and endeavours have been made to popularise simple home-made contrivances which can be constructed by the cultivators themselves at very little cost, and which are efficient and require little attention.

Deadfall—The deadfall trap was advocated by the Department of Agriculture in 1921 and two simple forms of deadfall trap which can be made at small expense are now largely in use. One known as *perangkap timpa* employs a flat board weighted with a big clod of earth and supported by a small wooden pin, which is connected to a trip mechanism situated near the bait. A slight movement of the mechanism causes the wood to fall upon the victim. Another form known as *kuching tuli* or *kuching pekak*, embodying a similar principle, is made in the form of a narrow trough for use in runs; in this case a heavy block of wood is released as soon as the trip is operated.

Bamboo—a very simple method of catching rats, and one that should have a large appeal to the padi cultivator since it does not require setting and needs very little attention, consists of a length of bamboo about four feet long, with all the nodes removed. The diameter should be big enough to allow a large rat to enter. The bamboos are concealed in the undergrowth or along runs therein, in such a manner that one end is invitingly displayed in the direction from which rats may be expected to come for cover after a nocturnal forage. It appears that rats will readily take cover in a well-placed bamboo, providing it has been thoroughly dried before use, and remain there much the same as in their own tunnels.

The traps are tested for a catch by simultaneously closing both ends with a handful of grass and shaking: the rodent may be disposed of by submerging the bamboo in an adjacent drain; a more popular diversion is to the club the animal to death as it is shaken from one end. As snakes are sometimes found in this form of trap, care should be observed in the method of despatch. Bamboos have the advantage of not being limited in their effective capacity, for more than one rat may be caught at a time.

Bamboos tried over a small area gave very satisfactory results, and the method is now being extended to test its possibilities on a large scale.

Ratfast—an adhesive preparation manufactured by Mr. Parker of Bagan Serai, was tried under field conditions. The material is placed in shallow trays with a bait in the centre. On exposure in the field it was found that the viscosity was affected by changes of temperature, and if the trays were not carefully placed the material was lost. No suitable technique for field use was evolved. Where shelter is afforded, however, as in houses and stores, ratfast can be used with excellent results.

Control Effect on Sex Ratio.

With a view to ascertaining whether any measure of control exerted an influence on the sex ratio of the rodent, an examination of rats killed by trapping and poisoning over a period of several months disclosed the following :—

Traps.		Poison.	
Males	Females.	Males	Females.
36,193	54,601	29,812	38,892

It would appear that both trapping and poisoning tend to displace the ratio in the direction most suitable for assisting in efficient control.

Species of Rats.

A large number of rats caught in the field have been submitted from time to time to the Institute for Medical Research, Kuala Lumpur, and Raffles Museum, Singapore, where identifications have been kindly undertaken. Some of the species, however, have not yet been definitely determined.

Based on information received and observations on specimens obtained, the Agricultural Field Officer, Krian, Mr. R. G. Heath, puts forward the following classification of rats of economic importance in the Krian district :—

1. *Rattus Norvegicus,* Malay *Tikus Mundok.*

The English brown or wharf rat, a very large animal with whitish feet and tail. Common in coastal areas in the vicinity of dwellings.

2. *Rattus rattus jalorensis.*

An indigenous, white-bellied jungle animal, tail rather longer than head and body combined; teats, 2 pairs pectoral, 3 pairs inguinal.

3. *Rattus rattus diardi.*

The "Commensal" dark-bellied form, frequenting homesteads, very similar to *jalorensis* in build, but underparts range from drab to chestnut.

4. *Rattus rattus argentiventer.*

The common rice field rat, tail normally shorter than head and body combined. Teats, 3 pairs pectoral, 3 pairs inguinal.

The Malay *tikus ladang* appears to embrace 2, 3 and 4 above.

It is not possible, at present, to indicate to what extent the species described above are responsible for damage in rice fields. It is of interest to note, how-

ever, that *Rattus rattus argentiventer* is the species most commonly met with in the open rice fields in Krian, while *Rattus norvegicus* and *Rattus rattus diardi* are localised—the former in the coastal area, and the latter in the inland districts of Selinsing and Gunong Semanggol. There is no concrete evidence that *Rattus rattus jalorensis* is a pest of padi although it is extremely likely that it is.

Although there is a definite movement of rats during the year, migration is not pronounced owing, no doubt, to the very mixed nature of the cultivation in the District, both within and without the rice-growing areas, and also to the presence of dwellings and towns, together with industries such as fish-preserving, poultry-raising and rice-milling, from which sources an adequate supply of food is available.

In the rice fields, a pronounced increase is evident following planting, and would appear to culminate after harvest. Damage to nurseries is, as a rule, only slight, and the main crop is not seriously attacked till it has become well established, when the succulent stalks are gnawed through near ground level, usually some distance from a bund, *batas* or other centre of rodent concentration. As the crop develops towards maturity, depredations increase in severity. At this stage there appears to exist a marked association between water supply and rat damage, as an excess of water is invariably accompanied by increased damage, possibly due to the facility thus afforded for reaching the ears; similar results are experienced if water is insufficient.

The appearance of a rice crop damaged by rats is very characteristic. In any plot where depredations occur, the damage is invariably confined to the centre; even in bad attacks, where the affected crop presents the appearance of having been trampled by heavy animals, the perimeter, especially if adjoining *batas,* is rarely even touched. The only reason that can be adduced for this systematic method of attack is that the crop which escapes attention forms a screen to shelter the rats and to hide the holes and runs in the *batas.*

Runs and tunnels are constructed on the banks of distributaries and drains, but these would appear to be used mainly for purposes of shelter and protection. During the breeding season, which extends from harvest (February) to about July, burrows are made in the dry grass bunds, and in these the young are produced. Undergrowth or accumulations of vegetable material may also be used to accommodate nests.

Breeding would appear to be extremely intensive and as many as eighteen young rats have been found in a nest. On one occasion, two nests were discovered side by side each occupied by a female nurturing two litters, one at teat and one just old enough to break for cover. The total of both nests amounted to fifty-six rats.

AGRICULTURE IN TRENGGANU

BY

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The following notes are abstracted from a fuller report on a tour which the writer made to Trengganu, at the request of the Government of that State, to report on agricultural conditions and to formulate proposals for agricultural development in Trengganu.

The writer takes this opportunity of thanking all officers in Trengganu with whom he came in contact, for their kindness and hospitality and for their help throughout the visit.

Trengganu is divided into four Administrative areas, their boundaries following the water-sheds and for the purpose of description it is most convenient to follow this arrangement.

The Jajahan Barat, comprising the two northern districts of Besut and Setiu, is drained by rivers of those names and forms a large coastal plain which varies in width from about three to twelve miles. In the north west, this plain is abruptly bounded by high precipitous hills, but over the greatest length of the district the plain runs into quartzite foot hills which in turn lead to mountainous country. The soils of this plain follow closely those found elsewhere on the east coast—namely, a high coastal bank of practically barren sand extending inwards from the sea for distances up to three or four miles, behind this sand a comparatively narrow belt of deep swampy organic soil from which a heavy alluvial loam stretches back to the foothills in the vicinity of which the soils become lighter in nature and contain a considerable amount of gravel and sand.

The Kuala Trengganu district is drained by the Trengganu river and its tributary the Nerus. The sequence in soils from the coast is similar to that found in Besut except that both sand and deep organic belts are narrower, the latter in places being absent. In this district also there is a very extensive plain, the soils of which vary more than those in Besut in that there is a considerable quantity of light-coloured clay or heavy loam in addition to the predominant alluvium. The soils of the undulating and hilly country on the western margin of this plain are of a coarse and easily washed character.

The Jajahan Timor is, in effect, an immense plain broken up by three low ridges of hills running roughly north and south. Between the sea and the first range only the coastal sand and organic soil types are found but beyond this, good alluvial and other light-coloured clay and loamy soils are found. In the vicinity of the Kemaman River, undulating land approaches rather more closely

to the coast than elsewhere and this soil is somewhat coarse and sandy. In the vicinity of Kemaman also there appears to be a greater proportion of the organic type than elsewhere.

Treated as a whole, the State comprises four main soil divisions: the coastal sandy strip of little or no agricultural value; the deep swampy region immediately behind the coast; the immense plains of loamy soil which merge into undulating country and foothills of a coarse nature.

The area of the State is computed as 5,000 square miles and the population in 1931 proved to be 179,000 persons. This population is, however, not distributed throughout the State, but is concentrated on the coast line, in Kuala Trengganu District and in the vicinity of the Besut river.

Agricultural development in other parts of the State is negligible and the little that has taken place is confined to narrow disjointed strips of river bank cultivation, for the people are primarily fishermen and little interested in agriculture, though in this connection it is probable that the barren coastal sand bank has formed a barrier discouraging them from penetrating inland or turning to agricultural pursuits.

The standard of knowledge on agricultural subjects and everyday procedure is, for a country population, surprisingly small, the people having no idea of adapting procedure to conditions and no knowledge of the varieties of rice or the cultivation of alternative crops. The people appear to be receptive of what were to them new ideas and are prepared to put those at least to the test.

Padi.

Four types of padi are cultivated in the State namely—

(1) Padi chedongan — Wet transplanted padi.
(2) Padi taboran — Padi broadcast on dry land.
(3) Padi tugalan — Padi dibbled in on dry land.
(4) Padi huma — Padi dibbled in on burnt off jungle land which is subsequently allowed to grow up in jungle.

The cultivation of wet padi in large areas is confined to Besut and Kuala Trengganu Districts. A few small native-built irrigation dams have been constructed though, for the most part, the crop depends for water on rainfall and the yield, therefore, fluctuates from year to year. In both of these localities the crop appears to be well cultivated and cared for. In other districts, cultivation of wet padi is confined to small and isolated blocks in which there is a marked lack of collective effort and only a slight understanding of pest control. In certain areas the most elementary principles of cultivation and water control are not understood.

Padi tugalan, on the lines of the Kelantan dry padi, is not extensively planted and though a few well-cultivated plots are seen, the principles underlying the cultivation of this crop are not generally understood so that correct procedure is often a matter of luck and the crop more variable than should normally be the case.

Padi taboran is grown on land suited to padi tugal and is planted either because the owner knows no alternative form of cultivation, or because he has too much land to plant and care for by the superior tugal method. After three ploughings and harrowings, the seed is broadcast and harrowed in and thereafter the crop is left to itself. Weeding is impossible and the padi becomes wholly or partially choked with grass. Seeding is too close to allow plants to develop properly and a great waste of seed occurs. This is an exceedingly wasteful form of cultivation from every point of view, but particularly in relation to land which is planted for two years and fallowed for one or two season the crop at its best can only be a partial success and can never be economic.

Padi huma is grown extensively throughout the State, but especially so in the Jajahan Timor and Ulu Trengganu. One is struck by the lack of primary jungle which is attributed to this wasteful form of cultivation. The jungle is felled and burnt off after which either one or two crops of padi are removed, the land then being allowed to grow up in secondary jungle and the cultivator moving to a fresh site.

Varieties of padi.

As might be expected, a number of the varieties grown in Besut are the same as those planted in Kelantan and the same applies to a lesser extent to Kuala Trengganu, but a fact which must have a very great effect in diminishing yields is that a large number of cultivators make no differentiation between types of padi and use the same variety on wet and dry fields. Whether this is due to the loss of types through careless storage of seed and mixing until seed gives the same yield under either condition, or whether it is due to some major calamity in the past wiping out the dry types is not clear. As might be expected under the circumstances, cultivators—even in the more advanced areas—have no ideas as to the best varieties for any particular soil type and it is probable that, even in Besut and Kuala Trengganu areas, varieties are so mixed as to mask completely differences in yield. The determination of the most suitable varieties of wet and dry types and the maintenance and distribution of these varieties is work of primary importance.

Rubber.

Rubber holdings seen throughout the State are, for the greater part, under a heavy cover of undergrowth bordering on forest conditions, though in this matter again Kuala Trengganu is superior to other localities. Tapping generally is of a low standard, but the quality of rubber produced is exceedingly high for small-holding produce and is definitely superior to Malay small-holders' sheet in the writer's experience of the Federated Malay States. The sheet seen in Paka Chukai and Kuala Trengganu was cleanly prepared and well cured by smoking. In Paka it was stated that hand rollers were either owned individually or by groups of three and four small-holders; the same remark applies to the small smoke-sheds seen which are constructed of roughly-squared timber

with walls of bark collected in the jungle, the fires being external and the smoke led into the sheds through hollowed-out tree trunks. Besut is the only district in which block rubber uncured and full of water, sand, bark and other impurities is prepared. The increase in export duty to the same figure as that for sheet, or the establishment of a diminishing quota system for this type of rubber would raise the quality and bring more money into the State.

Coconuts.

Extensive cultivation of this crop is confined to the sandy coastal belt, though one European-owned estate, which was not visited, exists near Kretir. Palms, except in thickly populated areas, have a somewhat unhealthy appearance and produce small yields. The copra produced, at least during the wet season, is of a low grade, the owners of holdings having no idea of adequate curing, or of the construction of kilns to effect this. The conditions pertaining to small yields and small holdings owned by fishermen point to the need for the adoption of co-operative kilns, but in this as in other things, education in market requirements, nut harvest and manufacture—which cannot at present be given—are urgently required.

Arecanut and Gambier.

These two products to the value of $112,000 and $42,000 respectively, were exported from the State during 1932. Arecanut normally occurs as a casual *kampong* crop and not in large defined areas. The nut is exported in both smoked-cured and sun-dried forms. No gambier holdings were inspected. Considerable areas of land suitable for one or other of these crops are available in Dungun and Besut.

Tobacco.

Cultivation of this crop has increased considerably in the last two years. Individual holdings are small though one estate of 10 acres owned by a Sumatran Malay has come into being at Batu Hampar. Small-holders' leaf is sun-dried and sold to local Chinese dealers who sort, press and chop the leaf and produce a type of tobacco popular among native consumers by treatment with groundnut oil and rouge.

Other crops.

The writer was impressed by the absence of crops other than those mentioned above; bananas and other fruit, tubers, beans and vegetables of all kinds appear to occupy the lowest place in the economic life of the *kampong*. The difficulty in obtaining a variety of planting material is obvious, and was mentioned by both raiats and school teachers.

School Gardens.

The only Government Schools visited were those in the Jajahan Timor, the gardens in all cases being situated on the coastal sand which makes the

raising of good crops difficult. In Kemaman and Paka, fair attempts at cultivation have been made, but there was a marked lack of variety in crops grown while lay out and cultivation were generally poor.

Stock.

The State carries an animal population estimated at 20,000 buffaloes, 23,000 cattle and 228,000 poultry as well as sheep, goats and pigs.

The greatest number of cattle and buffaloes are found in Besut and Kuala Trengganu Districts. The cattle are of the small Siamese type and are used entirely for draught purposes. In Besut, the animals are in much better condition than those in Kuala Trengganu, as in the latter District no adequate grazing is available. Hens and ducks are of good average quality and it is surprising that exports are only in the region of 500 head per annum. The organisation of groups of peasants to ship poultry to Singapore would give the people extra money and encourage breeding of poultry.

Epidemic poultry diseases are said to be common, but these can only be overcome by education in feeding, housing and general sanitation and the provision of veterinary facilities.

The very backward state of agriculture in Trengganu is attributed to a number of causes among which stands the nature and the sparsity of the population. As has been remarked before, the people are primarily fishermen and have little knowledge of agricultural practice. Except in Besut and Kuala Trengganu Districts, cultivated areas are small and isolated; this fact in itself makes for serious diminution of yields of all crops, owing to the depredations of pests and unless long distances to a centre are to be covered, reduces the available market to a few individuals. The peasant, therefore, tends to cater only for his own needs, produces no money crops and is unable to make purchases from the outside world or to pay land rent.

Trengganu with its huge areas of well-watered and unopened plain, has immense agricultural possibilities the adequate utilisation of which are of prime importance not only to the State but to Malaya as a whole. The lie of the land and the types of soil render the country suited to the cultivation of padi and a large variety of other food crops which would tend greatly to reduce the reliance of the Peninsula on imported supplies, but in this connexion it must be stressed that if it is the policy of the Government to convert the State into a rice-exporting country, it will be necessary to spend considerable sums of money on irrigation, for though dry padi will supply the food of the peasant it is seldom that this type will produce a saleable surplus. The country is one which in view of the nature of the land and the large number of rivers, appears to the layman to be ideally suited to irrigation. The provision of controlled water would, in addition to ensuring the padi crop, greatly increase the productivity of the land in other crops during the dry season.

Concurrent with the necessity for irrigation in a policy concentrating on rice production goes the need for milling facilities to provide a market for the crop. In view of the reliance on rainfall for irrigation water and the possibility of growing other crops during the dry season, the trial of certain heavy-yielding short term varieties of padi from the Pulau Gadong Station in Malacca would be valuable.

In the normal course of events, cultivation must for a large number of years be confined to the plains occurring throughout the State and on these a system of dual cropping—padi followed by a short term crop during the dry season—should be encouraged. The actual crops most suited to conditions are a subject for experiment, but until this has been established, tobacco, groundnuts, loofah, cucumber, brinjal, chillies and cow-pea and possibly soya bean are suggested as suitable crops. In localities where large holdings of dry land result in the cultivation of padi taboran it would, for the present, be in the interests of the State to encourage peasants to adopt the *tugal* system of cultivation on a smaller area and plant the remainder of their land with either long- or short-term food crops.

The efficient cultivation of available land and the development of potential land on the lines indicated, by people having such a rudimentary agricultural knowledge, is impossible and unless provision can be made for Agricultural Services to educate the peasantry and carry out experiment and demonstration work, waste of land and the loss of very great potential supplies to the whole country will result.

THE CO-OPERATIVE MARKETING OF EGGS IN MALAYA

BY

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It is a matter for surprise that in Malaya, which is predominantly an agricultural country, it should be found necessary to import large quantities of poultry and eggs; but such is the case, and from the figures given below it will be appreciated that the imports are on a considerable scale.

Net Imports into Malaya of Poultry & Eggs.

Year	Poultry, Alive		Poultry, Dead		Eggs, Fresh & Salted		Total value Poultry & Eggs $
	Quantity No.	Value $	Quantity Tons	Value $	Quantity per 100	Value $	
1930	1,120,972	1,011,720	89	124,309	488,185	1,249,369	2,385,398
1931	875,727	708,286	74	89,890	377,672	692,085	1,490,261
1932	930,597	611,685	37	43,608	170,733	293,305	948,598
1933	826,598	515,294	46	45,349	203,402	316,302	876,945

An investigation of conditions among the Malay poultry owners in the District of Krian, in which it was known that considerable numbers of poultry were kept, showed two factors which militated against the popularity of keeping poultry. In the first place, the flocks were liable to be decimated by disease and in the second place, the price paid for eggs to the poultry owners, who carried the risk of losing the birds in addition to the labour of looking after them and the expense of feeding them, was ridiculously low. The majority of the rayats were in the habit of selling their eggs to higglers, usually of Chinese nationality, who travelled round the kampongs and paid on an average about fourteen cents for ten eggs. The eggs eventually arrived in the markets and were then retailed at from twenty to thirty cents for ten.

This method of marketing is obviously most unsatisfactory, both from the point of view of the poultry owner and of the ultimate purchaser in the market. The price obtained by the seller is insufficient to encourage poultry-rearing on any scale while the egg, by the time it reaches the breakfast table, is almost inevitably stale.

A solution of the problem appeared to be possible by introducing among the rayats a method of marketing eggs on co-operative lines and efforts were made in March and April 1932 to interest the members of the Tebok Haji Musa Rural Co-operative Credit Society in a co-operative scheme and to find a market for their eggs. The first order obtained was from the Runnymede Hotel, Penang, and a regular supply to this Hotel has been maintained ever since.

There are, of course, on the market most elaborate machines for grading and candling eggs, but naturally the use of any expensive apparatus of this kind is out of the question when working in a Malay *kampong* on a small scale and a simple method of candling and grading, which however proved in practice to be quite efficient, was evolved. The *modus operandi* adopted by the Society was for the eggs to be brought in daily to a collecting station by the individual members and, after being graded to eliminate small ones, they were candled to ascertain whether they were new laid. Those which passed these tests were then "chopped" with a rubber stamp "Co-operative Poultry Products" and the member credited with the number of eggs accepted. For packing purposes it was found that the small wooden cases used for importing tins of condensed milk were procurable at about six cents each and, after a few trials, it was decided that a case would hold 200 eggs with reasonable security from damage. Fortunately, as Krian is a padi-growing District, there is always plenty of padi husk available and this was found to be an excellent medium for packing. After the business had been carried on for a few months, suspicion arose that consignments were being tampered with and to overcome this difficulty the cases were bound with wire and the wire sealed before despatch from the Society.

This experiment having worked satisfactorily for a few months, it was decided to extend the scope of the operations and an Agent was found who was willing to open a stall in the Kuala Lumpur Market and to make house to house deliveries. In order to maintain the supply, three more Rural Credit Societies in Krian were brought into the scheme in September 1932. During October and November, supplies were despatched to the General Hospital, Singapore, but this order was, for various reasons, terminated and it was decided to concentrate on supplies to marketing centres nearer to Krian than Singapore.

At the outset, each Society worked individually, but in November 1932 it was arranged that a Union of the four should be formed and a flat rate paid to the members as the Societies which were fulfilling the least lucrative orders naturally regarded it as a hardship that the net price obtained should vary in the different Societies. It was found impossible to fix a standard price for all orders, as market prices varied in the different centres which were being supplied and the prices paid to the Societies had necessarily to be varied in order to compete with the local dealers. No attempt was made to undersell the local dealers and the prices charged were if anything slightly higher, the Societies relying upon selling an egg of a fairly standard size and, moreover, of a guaranteed freshness.

In order to reduce the time from the *kampong* to the consumer it was decided that consignments should be sent by passenger train, although this entailed a greater expenditure upon freight and a reduction of the net profits. The usual course in the case of consignments to Kuala Lumpur is for the eggs to be collected in the morning in Krian, examined for cleanliness, graded, candled, stamped and packed and finally despatched by the night mail to Kuala Lumpur. They are collected by the Kuala Lumpur Agent at 6.30 a.m. and as a general rule, are disposed of the same morning so that there is no reason why they should not be available for the breakfast table less than 12 hours after leaving Parit Buntar Railway Station.

In the year 1932, the four Societies concerned sold 143,000 eggs and realised thereby $3,520. The following year an Agent was found who was willing to sell the Societies' eggs in Ipoh and a regular order was obtained from St. Margaret's School, Fraser's Hill. During the year, the Societies engaged in this business sold 278,430 eggs and the average net price paid to the members throughout the year, after deducting all expenses, amounted to $1.92 per hundred, which must be considered satisfactory, as the average price per hundred which would have been paid by the higglers would have been in the neighbourhood of $1.40 only. In addition, the business gave permanent employment to five Malays.

There is no doubt that the members of the Societies engaged in the co-operative marketing of eggs are fully alive to the benefits which have been derived from the business and when, during temporary scarcities of eggs, the higglers offered higher prices they remained loyal to the Societies and maintained their regular supplies.

The only serious criticism, so far, has been that the average size of the eggs is small. The blame for this lies with the poultry and not the co-operators and now that those concerned realise that there is a reasonable profit to be made by the marketing of eggs on co-operative lines, the improvement of the breed and an increase in the number of poultry kept in the kampongs should follow as a natural corollary.

FISH PRODUCTION IN THE KRIAN IRRIGATION AREA

BY

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Fish production constitutes an industry of some economic importance in many parts of the Krian irrigation area. It is an industry intimately bound up with padi cultivation and one that provides a valuable source of revenue for the Malay cultivator, additional to that which he receives from his padi crop.

The fisheries depend entirely on air-breathing fishes belonging to one or other of the following families :—

(1) Anabantidae
(2) Ophiocephalidae
(3) Siluridae.

Of the fishes commonly met with, the "sepat" ("sepat Siam" and "sepat padi") together with the "puyu" (climbing perch) belong to the first, the "aruan" (murrel or serpent heads) to the second and the "keli" (catfishes) to the third group.

The most important fish is the "sepat Siam" or "sepat benua" (*Tricopodus leeri*). This fish was introduced into the mukims of Bagan Tiang and Tanjong Piandang some years ago and has since spread throughout the district.

The "sepat Siam" is an extremely hardy fish, a prolific breeder and of high value as a food owing to it's oily character. The fact that it is air-breathing makes it easy to transport; this feature, combined with it's breeding habits, renders it possible rapidly to populate a new area by introducing merely a few pairs of the fish.

Among the Malay cultivators, there are many who dislike "sepat Siam". They insist that it is an extremely pugnacious fish and drives away good fish like "aruan" of which they are extremely fond. This may or may not be the case; but primarily, it is a vegetable and silt feeder, preferring to grub around the roots and stems of the padi and other plants seeking a mixed diet of algae and infusoria.

During the padi season, the "sepat Siam" are caught in the padi fields, irrigation canals, drains and other water courses. Catches are heavy during rainy weather. Following a heavy storm, many people can be seen at work with cast nets (M. jala), lift nets (M. tangkol) and rods reaping the benefit of the washing into the drains of large quantities of fish of all kinds, more particularly of "sepat". It is said that on occasions of this kind, cultivators may catch, in one morning, fish to the value of from 50 cents to $2.

A very common method of capturing "sepat Siam" in Krian is by means of wells (M. telaga) in the padi fields. These wells vary in size. In the coastal mukims, 30 ft. x 20 ft. is a common size and there is normally only one well

to each Lot of approximately 5 acres of land; whereas in central and south Krian the wells are usually much smaller, and there may be two or more to each Lot. The wells are dug in the lowest portions of the padi fields so that they retain water even when the rest of the field is dry. Coconut palms are often planted around the edges of the wells to provide shade. The fish breed in the wells, spreading over the fields after irrigation has taken place. They are caught in the fields, largely by means of rods, during the growing period of the padi. When the padi is ripening and the water is being run off the fields, the fish collect in the wells. The wells are then bailed out and all the fish are taken except a few, which are retained for the next season's breeding. Many small water courses, such as exist around house sites, are similarly cleared. The bulk of the catches from wells usually consist of "sepat Siam". Most of the "sepat Siam" caught by the Malay cultivators are sold fresh to Chinese dealers at a price varying from $1 to $4 per pikul. The Chinese behead and gut the fish which are then salted and sundried. From 2½ to 3 pikuls of fresh "sepat Siam" are required to prepare 1 pikul of the salted and dried product. Considerable quantities of salted "sepat Siam" are exported to Sumatra and Java as well as sold in the local markets.

Yields of fish taken from wells vary considerably. It is said that some wells are capable of producing a return of as much as $70 per annum, but a more usual figure would be from $10 to $40 per annum. The heaviest yields are recorded in the coastal mukims. The following figures taken from Kuala Kurau in April 1932 give some idea as to the yields attainable: —

Size of well		*Yield of fish in kati*
18 ft. x 32 ft. x 6 ft.	...	500
19 ft. x 29 ft. x 6 ft.	...	1100
20 ft. x 32 ft. x 6 ft.	...	600
21 ft. x 30 ft. x 6 ft.	...	2800
18 ft. x 30 ft. x 6 ft.	...	280
22 ft. x 32 ft. x 6 ft.	...	1300
20 ft. x 30 ft. x 6 ft.	...	400
22 ft. x 32 ft. x 6 ft.	...	900
20 ft. x 30 ft. x 6 ft.	...	300
21 ft. x 32 ft. x 6 ft.	...	900

A small well at Titi Serong Experiment Station, size 24 ft. x 24 ft. x 6 ft. yielded in January 1934, 200 kati "sepat Siam", 50 kati "aruan" and 100 kati "keli". Taking the prices ruling at the time of 2 cents per kati for "sepat Siam", 5 cents per kati for "aruan" and 3 cents per kati for "keli", the value of the catch works out at $9.50. In 1932, an irrigation drain at Kuala Kurau 360 ft. long, 8 ft. wide and 6 ft. deep, yielded 16,000 kati of fish.

Associated with the "sepat Siam" is a smaller species known as "sepat padi", "sepat jawi" or "sepat ronggeng" (*Tricopodus trichopterus*). This species seldom exceeds 3 to 4 inches in length as compared with the 7 to 8 inches

of "sepat Siam". Carrying, as it does, a very small amount of flesh, it is of little value as a food.

Next in importance to "sepat Siam" are the fishes belonging to the genus Ophiocephalus and known collectively as "aruan". These are predatory fish and feed largely on frogs and small fish other than "sepat" and "keli". They breed largely in shallow water, often among the grasses and weeds alongside the division ridges of the padi fields. They are capable of travelling overland and can bore through the division ridges of fields in cases of necessity. They grow to a fair size and, when full grown, may weigh from ½ to 1½ kati. They are caught by means of rods or sometimes with long poles baited with dead frogs. They are also found in wells, although "sepat Siam" provides the bulk of the catches taken in that way. Only occasionally are "aruan" captured in traps. The Malays sell the greater part of their catches of "aruan" to the Chinese, but preserve a certain amount for their own use by salting or pickling (M. pekasam). "Aruan" transport well and are sold alive in the markets of large towns at a retail price of from 10 to 16 cents per kati. The local dealers purchase "aruan" from the Malays at prices from 4 to 10 cents per kati.

Third in importance are the "keli' or catfishes (Clarias sp). These fishes are omnivorous, they feed largely on excrement, but it is doubtful whether, under the Krian conditions, they can obtain sufficient to make it an important article of diet. They also devour frogs, frog spawn, larval insects and small fishes. They are furnished with special accessory organs of respiration and can travel overland, sometimes for considerable distances; they are also able to bury themselves in the mud and survive for a considerable period without water. They are prolific breeders. They are caught mainly in traps in the padi fields, but are also met with to some extent in the wells. Not all Malays appreciate the "keli" as food, but a proportion of the catch is usually salted or pickled and preserved by them, the remainder being sold fresh to Chinese dealers. They transport well and are sold alive in the markets of the large towns. The local dealers purchase "keli" from the Malays at prices from 4 to 7 cents per kati.

The "puyu" (*Anabas scandens*) belongs to the same family as the "sepat". It grows in some cases to a size of 6 to 7 inches and is very much relished as food by Malays. It feeds largely on moss and lichens. It is not so commonly met with as "sepat", "aruan" or "keli" and is mainly caught in traps. The bulk of the catches are not sold, but are retained by the Malays for pickling and preserving to tide them over the dry season.

All the species of fish mentioned above flourish in the padi fields of the Krian irrigation area. They bring to the Malay population of the District, more particularly in the coastal mukims, a useful item of revenue additional to that derived from their padi crop. In some cases, the value of the fish produced is said to be worth as much to the cultivator as is his surplus rice crop. In the majority of cases, fishing provides him with the means of paying his land

rent and water rate. It is a source of income requiring but little exertion to obtain and one that might well be adopted by the Malay cultivator in other parts of the country where conditions are suitable for the purpose.

It is, unfortunately, impossible to obtain full data relative to the exports from the district of fish caught in the padi fields of Krian. This is due to the fact that three of the four important varieties of fish caught, namely "aruan", "keli" and "puyu", are exported fresh and are not subject to any form of export duty. Figures supplied to the writer by the courtesy of the Superintendent of Customs, Krian give the exports of dried "sepat" from Krian district during the year 1933 as amounting to 2609 pikul 73 kati, the bulk of which went to Penang. These figures do not by any means represent the true state of affairs, however, as a large part of the catch is transported, in a fresh condition, over the boundary into Province Wellesley, there to be salted and sundried.

The Fisheries Officer reports that from six Chinese dealers in 4 centres 6,500 piculs (382 tons) of fish were exported in 1933 to Singapore and Penang.

The Malays of Krian district take little or no part in the marketing of the fish captured by them. Taking into account that salted and sundried "sepat Siam" is retailed in the towns at a price of 20 to 22 cents per kati whereas the fresh fish is sold by the Malays to Chinese dealers at 1 to 4 cents per kati ($2\frac{1}{2}$ to 3 kati "sepat Siam" will give 1 kati of the salted and sundried product), it seems surprising that the Malays do not make an effort to perform the salting, sundrying and marketing operations themselves. There would seem to exist a definite scope for the introduction of some form of co-operative preparation and marketing as regards the production and sale of "sepat Siam" in Krian District. The same remarks are applicable to the marketing of fresh fish such as "aruan" and "keli". The main drawback to the initiation of co-operative methods seems to be lack of capital on the part of the Malay producers. The capital required to initiate such methods would be large, inasmuch as the Malays would require prompt payment in cash for fish supplied.

In conclusion, the writer wishes to express his gratitude to Mr. W. Birtwistle, Officer-in-charge, Fisheries Department, S.S. and F.M.S. for the very considerable amount of information and assistance rendered by him in connexion with the preparation of this article.

Note.—1 kati = $1\frac{1}{3}$ lb. 1 picul = 100 kati.

Abstract.

PAPAYA AND PAPAIN. *

General Information.

The papaya or papaw is a fruit tree widely diffused throughout tropical regions. It has attracted attention because of the papain contained in the whitish latex of the the stems, leaves and rind of the fruit, containing an enzyme by means of which albuminoids may be dissolved and digested, so that it serves the same purpose as pepsin.

The exports of papain from Ceylon have increased considerably in recent years. The exports from that country in 1932 amounted to 64,356 lbs., valued at Rs. 338,247. Of this quantity, 16,022 lbs. were consigned to the United Kingdom and 45,575 lbs. to the United States of America. The total imports of papaw juice or crude papain into the U.S.A. in 1932 were 54,491 lbs. : 80 per cent. of these were from Ceylon.

Little is known of the trade channels followed by the powders imported into the different countries, so that no information can be given as to the requirements of the markets and it would be inadvisable to encourage the cultivation of the papaya tree and the extension of the papain industry, although, in certain tropical regions, it might attain some degree of importance. Under present conditions, planters could be advised to take up papaya growing only if they were assured of a market for their products.

Distribution of the Sexes.

The papaya tree is generally described as being dioecious,† but this is not true of all varieties. The only question of interest for growers is the possibility of being able to determine the sex of the young plants, or of the seeds. There is at present no evidence that this can be done; there remains, therefore, only one method of eliminating the possibility of rearing too many useless male trees; namely, to put several plants in each hole when planting—four plants per hole is recommended.

Cultivated Varieties.

Papayas vary considerably in appearance, but it is observed that the habits of the trees, as well as the shape, colour and aroma of the fruit, are much influenced by the conditions under which they are grown; as for example, sun, temperature, humidity, aspect. There are also certain hereditary characteristics. As cross-fertilisation is not easily avoided there must always be undesirable types amongst the descendants of trees which are not isolated. Consequently, it is advisable to establish small and isolated plantations of superior trees, for the sole purpose of seed production.

* Abstracted from an article by W. Bally in the *International Review of Agriculture* Year XXIV No. 11, November 1933.

† Having the male and female flowers on separate plants.

Establishment of a Plantation.

Papayas are generally reproduced by seed. Fresh seeds germinate in from 10 to 50 days; the rate of germination depending upon the degree of exposure to light. The best results are obtained if the seedbeds are exposed to the sun from 7 to 11.30 a.m. and shaded during the afternoon.

The seeds are sown in shallow trays or in the ground and carefully covered with a thin layer of sand. The plants should be transplanted at the end of three or four weeks. Another method of planting consists in placing from 4 to 6 seeds in a bamboo basket which, after germination has taken place, can be put in the final position in the field. It is advisable to cut off about 3 to 4 leaves before each transplantation, in order to avoid excessive transpiration. It appears that even plants which have attained a height of 2 metres may still be transplanted. It is possible, therefore, to replace male by female trees, even at an advanced age.

Many attempts have been made to reproduce papayas by vegetative methods. Though a certain measure of success has been attained in individual cases, the conclusion is reached that none of these methods has any practical value.

The usual spacing of trees is at a distance of about 7 feet each way.

The use of fertilisers is very generally recognised. The tree is most susceptible to potash and phosphate deficiency. It is important that careful research should precede manuring in order to determine the fertilizer requirements for the particular region.

Topping of trees has been advocated, but its advantages are uncertain.

There are certain advantages in intercalary crops. In British India tomatoes are chosen, but there are many other possibilities.

Opinions differ as to the age that a papaya plantation may attain. The yields of papain are most abundant during the first 3—4 years. It is advisable to replace the trees periodically so that the productive period of each tree never exceeds five years.

Diseases and Pests.

The diseases and pests by which the plant is attacked are not numerous and play an unimportant part. Papayas suffer from an excessively damp soil. The roots soon decay and the trees die shortly afterwards.

Papain and its Collection.

Papain is contained in the latex of the papaya. The characteristic properties of papaya latex were known as early as the 18th. century.

The latex tubes are found in all parts of the plant and the latex exudes whenever an incision is made; they are, however, most numerous in the outer skin of the fruit.

Many experiments have been carried out, from time to time, to discover the best methods of tapping the fruits. Earlier writers stated that the incisions

must be made with horn or ebonite knives and that the use of steel knives must especially be avoided as it tended to cause discoloration of the latex. These statements have been constantly repeated. The author, however, has tried steel knives and never observed any such discoloration of the latex. Preference should, in fact, be given to steel knives, as the edge is sharper and greater quantities of latex can thus be obtained. Pieces of broken glass can also be used. The latex can be collected in jars of aluminium, glass or porcelain.

The best results are always given by the first incision and, moreover, the papain coming from the first incision has the greatest proteolytic activity. Not more than four incisions should be made at a time on each fruit. Young fruits give small yields. The yields increase with the maturity of the fruit, attaining a maximum in fruits about three months old which have finished growing. All experiments indicate that the fruits should be tapped when at the age of 100 days and that two incisions should be made, returning every three days to the same fruit.

Preparation of Papain.

The most primitive process consists of spreading the latex on dishes and drying in the sun. The product so prepared will not have a satisfactory appearance; papain thus dried is brown or even blackish in colour.

Drying in furnaces, or in special sun-driers gives better results. The ideal preparation is, however, not obtained by these means for Hofstede has shewn in numerous experiments that drying *in vacuo* is the only method that makes it possible to obtain a product white in colour and with a proteolytic activity remaining intact even in alkaline media. For this reason in particular, prospective planters of papaya and manufacturers of papain are recommended to consult Hofstede's work.

Planters who intend to prepare their own product are accordingly advised to procure a plant for vacuum drying. A German model is described by the author, containing five shelves of 5 x 10 cm. spaced 6 cm. apart, by means of which about 2 kg. of dry papain can be prepared in about two hours only. The apparatus costs 2000 florins (Dutch) and to this must be added the cost of purchasing a dynamo for working the vacuum exhaust, amounting to about 500 florins; and further, there must be added the costs of packing and transport of the apparatus and the motor plant, including any customs charges, amounting to about 750 florins. This may seem a somewhat large outlay, but it guarantees the possibility of a regular supply of a product which, in practice, is certain to be appreciated by the purchasers.

The methods of papain purification are also described in the work of Hofstede; they are, however, too costly to be applied on the plantations and, as the crude papain always finds purchasers, the necessity for the manufacture of papayotine (refined papain) has not been experienced in tropical countries.

Yield.

Tapping of fruits may be begun ten to fourteen months after sowing. Lucrative yields can only be expected over a period of about three years. The different statements as to yield per tree or by acreage shew little correspondence. According to Hofstede's calculations, the yield per hectare amounts to 186 kg. in two and a half years if the trees are planted at distances of 4 m. x 4 m. apart, i.e. 625 trees per hectare, including 10 per cent. male plants; and to 300 kg. if the spacing employed is 3 m. x 3 m., or 1000 plants per hectare. The Principal of the Harcourt Butler Technological Institute at Cawnpore gives for the second season's tapping a yield of 28.7 lbs. per acre (32.1 kg. per ha.), and for another orchard 11.9 lbs. per acre (12.3 kg. per hectare), figures much lower than Hofstede's. The author estimates on the assumption of 250 trees per acre (617 trees per hectare) a production of 41.6 lbs. per acre, or 46.6 kg. per hectare.

Financial Return.

The price of papain on the New York market is taken as the basis of all calculations. In 1927 Ceylon papain was sold at 15.89 florins (Dutch) per kilo on the spot and it was as much as 17.40 florins in New York. The approximate range of prices in recent years, in shillings per lb. is as follows:— 1925, 10 shillings; 1926, 18s.; 1927, 10s. 9d.; 1928, 16s.; beginning 1930, 7s. 6d.; end 1931, 10s. The latest quotation is given at 1.50 dollars to 1.60 dollars Gold per lb. (6.23 to 7.69 florins per kg.).

Hofstede has given estimates relating to an imaginary plantation of 13 hectares. On the assumption that such an undertaking may yield 2400 kg. of papain (which seems a generous estimate) and supposing that the factory possesses vacuum drying apparatus of improved type, Hofstede arrives at a cost price of 5.63 florins per kg. With the selling prices of 1927 there was thus a fair margin of profit. The profits resulting from the sale of fruits or products of the intercalary crops are not shewn on the balance sheet.

The estimates of the Cawnpore returns are of even more interest, since they are based on an actual example: a plantation of 2 acres which has been used as an experimental orchard. With the help of these data, compiled over three years, the author has established an estimate of the costs and profits of an imaginary plantation of 10 acres, carrying 250 trees to the acre. At the end of the second year the profit is 1216 rupees. In the total sum of the returns there figure:—(1) sale of the papain (416 lbs. at 12 rupees per lb.) producing 4992 rupees, (2) sale of the fruits, producing 3750 rupees.

The economic conditions in British India and Java are too diverse for comparison to be possible between these two estimates. It appears to be easy in Cawnpore to effect sale of the fruit; in Java there are difficulties, since the papaya is everywhere cultivated and there is always a great abundance of the fruit. In addition, in connexion with Cawnpore the sale of tomatoes is mentioned, producing 263 rupees in the first year of the trial plantation.

Uses of Papain.

In spite of increasing knowledge of papain, the number of purchasers remains limited. It appears that small consignments received regularly at Hamburg remain for some considerable time in the warehouses before finding purchasers. This is attributed to the fact that the proteolytic activity of papain is lower than that of the animal ferments. One authority in the trade states "Non-purified papain dissolves a quantity of albumin 200 times its own weight. Hence to digest 10,000 lbs. of albumin, 50 lbs. of papain would be required, while one lb. of pepsin is enough to produce the same effect, it should be added that the price of a lb. of papain is about 10s., while that of pepsin is about 2s."

On the other hand, reference may once more be made to the extent to which the importation of papain has developed in the United States. No information is available as to the uses in the United States, and hence all that can be done is to enumerate the various uses mentioned in publications consulted.

Reference is made to the use of the latex of the papaya for making tough meat tender. There would appear, however, to be limitations in this direction as it can only have this effect by direct contact.

Papain is used medicinally as a digestive to replace pepsin. Its use for this purpose, however, is limited by reason of comparative prices and also by the difficulty of obtaining papain in good condition which has preserved its full proteolytic activity.

Medicinally, papain has been employed in the combatting of cancer, diptheria and as a vermifuge.

Papain solutions have been used for reduction of fat and also as a substitute for rennet. It is certain that papain sometimes enters into the composition of chewing gum in America, which perhaps may be the explanation of the imports into the United States. It should be added that certain patent remedies contain papain and that it also enters into the composition of various milk flours.

The uses of papain are, in short, only very imperfectly known, but it is known that large quantities are imported into the United States of America.

Utilisation of the Fruit.

In certain cases the fruit may contribute something to the return from a plantation. The tapping of the fruit for the collection of the latex has no effect on the taste of the fruit.

The drying of the fruit has been suggested. It appears that the "flakes" thus prepared contain 10 per cent. of the moisture and 50 per cent. of the sugars and that vitamins of the ripe fruit are preserved if the drying is effected properly.

(Since the preparation of the above Abstract, our attention has been drawn to the latest number of the *Bulletin of the Imperial Institute,* Vol. XXXI, No. 4,

January 1934, in which there is a "Note on Preparation and Marketing of Papain." This article briefly states methods of tapping, yields, drying, packing, prices and grades of this product and gives a list of publications which deal with the subject.

It is stated that the price in December 1933 of average quality was 6s. 9d. per lb., and that oven-dried papain usually commands a premium of 3d. to 6d. per lb. over sun-dried.

The exports of papain from Ceylon in 1932 were 64,356 lbs. as compared with 76,947 lbs. in the previous year, 79,338 lbs. in 1930, 128,463 lbs. in 1929 and 125,684 lbs. in 1928. Of the 1932 exports, 45,575 lbs. went to the United States of America and 16,002 lbs. to the United Kingdom. The exports to the U.S.A. have steadily declined during the years under review; in 1928 they amounted to 111,877 lbs., while in 1932 they were 45,575 lbs. On the other hand, exports from Ceylon to the United Kingdom have slightly increased, being 11,054 in 1928 and 16,022 lbs. in 1932.—*Editor.*)

Reviews.

Present Position of Agriculture in the West Indies.

being a "*Report by Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies, on his Visit to the West Indies, 1933*". 40 pp. Colonial Office, December 1933.

The title of this document is an insufficient statement of the subject matter. In his introductory paragraph the author states in reference to his tour—

> "An endeavour was made to acquire, so far as time permitted, a fair picture of the present position of agriculture in the West Indies and of the lines of development which were projected."

The Report is in fact, a concise review of the present position of agriculture in the West Indies.

Nearly half the Report records the matters dealt with by the West Indian Inter-Colonial Fruit and Vegetable Conference, 1933. As the findings of this Conference have been published in the March 1933 number of the *Malayan Agricultural Journal,* further comment in this place is unnecessary.

Reference is made to the West Indian Sea Island Cotton Conference 1933. This body decided on the formation of a West Indian Sea Island Cotton Association for the promotion and protection of the local cotton industry. The Association will be financed by a cess on lint exported. Further, the Conference allocated an agreed production of cotton in this area for the coming year in order to maintain prices by avoiding over-production.

The author also attended meetings of the Committee of the Central Cane-Breeding Station, Barbados. A brief review is given of the work of the Station and future possible developments are discussed.

A section of the Report is devoted to agricultural matters of special interest discussed in the course of the visit, from which one may gain an idea of the major problems affecting agricultural development, on which work is projected at the present time.

In conclusion, Mr. Stockdale states that sugar producers were reasonably optimistic in regard to the future and are obtaining increased production annually. Cocao producers generally were depressed and fear that unless conditions improve, forced sales of cacao properties are inevitable. Banana growers in Jamaica have suffered severely of late by reason of storms and floods, but knowing the recuperative powers of their Colony, are still optimistic in regard to the future; while an improvement in the Sea Island Cotton industry has aroused new hopes in the producers in those drier islands where this crop is the main stand by.

> "The main problems which await solutions are those associated with the Panama disease of bananas in Jamaica and the witch-broom disease of cacao in Trinidad."

In view of the great importance of these crops to the Colonies in which they are grown, the need for scientific research, towards the solution of these problems, and unhampered by lack of finance, is emphasised.

D. H. G.

Banana Storage.

By C. W. Wardlaw and L. P. McGuire. H. M. Stationery Office, London. E.M.B. 72. 35 pp. 6 figs. Sept. 1933. Price 1s. net.

The investigation detailed in this interesting publication is a continuation of work prevously published by the same authors; *vide,* E.M.B. Reports Nos. 36 and 45. The present report is an account of recent investigations into the storage behaviour of several varieties of bananas, either well known in the West Indies or of hybrids evolved by the College Departments of Agriculture and Botany.

The Giant Governor, believed to be a tall mutant of the Dwarf or Cavendish variety, has given promising results in the course of four bulk storage trials. The bunches are larger than the Cavendish, while the cylindrical shape and symmetry of the bunch and the relatively tough skin of the fruits render it suitable for naked bulk transport. The degree of ripeness for storage is discussed in addition to response to varying degrees of temperature in storage. Shipping trials have yet to be made and the results of such trials should be of great interest.

The Cavendish or Governor variety proved very subject to mechanical injury and is unsuitable for export.

Similar work on other varieties is detailed, as a result of which it can be stated that certain varieties are unsuited to storage, while further trial on other varieties would appear justified.

D. H. G.

Departmental.

FROM THE DISTRICTS.

The Weather.

Conditions during March were nearly normal in Kedah and Kelantan, though the rainfall was somewhat below the average and in the eastern State the second half of the month was hot and dry. There was an average or slightly deficient rainfall in Province Wellesley, most parts of Perak and the inland northern half of Selangor. Around Taiping, in the Dindings and Sitiawan, on Cameron Highlands, in the remainder of Selangor and in all the south of the Peninsula from Negri Sembilan to Singapore Island, the rainfall was much above average, being especially heavy in the first half of the month when floods occurred in Johore and Singapore Island.

Remarks on Crops.

Rubber.—There was again a rise in the average price of rubber during the month. The lowest and highest prices in dollars and cents per picul recorded for rubber from small holdings were:—Smoked Sheet $16.50 to $24; Unsmoked Sheet $12 to $22.50; Scrap $4 to $10. The average Singapore prices for these grades were respectively $22, $20.50 and $7.50 as compared with $20, $18.50 and $8.50 in February. Penang prices for Unsmoked Sheet ranged from $19 to $22.50 as compared with $15 to $20.50 in February.

The fairly general wet weather rendered wintering irregular and prolonged so that in many areas it did not terminate until the end of the month. In spite of the wintering season, tapping was maintained over an increasing area and in some localities with increased severity under the stimulus of the rise in price.

A better return for the product has, however, led to improvement in the upkeep of small holdings, interest in the preparation of good quality sheet, including better facilities for smoking it before sale to dealers, and to the more extended use of approved disinfectants for the control of bark diseases.

Leaf mildew caused by *Oidium Heveae* was definitely recorded in Kedah for the first time, though its presence had previously been suspected. This disease appeared fairly generally in Penang and Province Wellesley, Selangor, Negri Sembilan, and Malacca and in parts of Perak and Johore. Its incidence was, however, on the whole not severe, owing to the unusually wet weather prevalent in many infected areas. Only two or three estates had resort to treatment with sulphur dust. It was observed independently in Province Wellesley and Negri Sembilan that trees which had wintered early appeared to have escaped infection.

Padi.—The price of padi at the Government Rice Mill, Bagan Serai, remained at $1.40 per picul, although a privately owned mill was offering $1.10

to $1.20 per picul. The price in Kedah was equivalent to approximately 97 cents to $1.25 per picul, and in Province Wellesley to about $1.25 to $1.30 per picul. Elsewhere prices varied in the villages between 4½ and 10 cents per gantang, being as high as 15 cents in some inland localities in Selangor.

Harvesting was nearly completed in Kedah, Province Wellesley and Penang, Krian and Malacca. Records of yields so far obtained indicate that crops in all these areas will be good. The Kedah crop is expected to approximate closely to that of last year, while in Krian about 150,000 piculs, or some 8,800 tons, of padi have already been purchased by the Government Rice Mill.

As anticipated, the harvest in other parts of Perak has been prolonged, with the result that yields have been variable and loss has been occasioned by wet weather during the past month. The position is similar in the new padi area in Sabak Bernam District of Selangor.

Work in preparation for the coming season has been commenced in the inland Districts of Selangor, in Negri Sembilan, except Kuala Pilah District, and in parts of Western Pahang and Johore.

Coconuts and Copra.—The price of copra remained very low, showing little change from that of February, being on an average $2.30 per picul in Singapore. Prices elsewhere ranged from $1.40 to $3.30 per picul.

At the present price, copra production is hardly remunerative. Consequently, every opportunity is taken for sale of fresh nuts within the Peninsula and the local preparation of coconut oil as a village industry is increasing in some localities. It is reported from Johore that fresh unhusked nuts are being exported from Benut to China, the fibre being utilised there for rope-making and other purposes and the nuts being consumed.

Pineapples.—The supply of fruit increased during the month, but the peak supply for the season in Johore is not expected to be reached until April. Three factories were working in Singapore Island, seven in Johore and one in Selangor. Prices for fresh fruit in Johore were, first quality $2.80 and second quality $1.50 per hundred. Corresponding prices in Johore ranged from $2.00 to $2.20 and $1.40 to $1.50 delivered at the factory.

Legislation on the lines of the Colonial Ordinance to control and improve the industry was passed in Johore during the month.

In Selangor it was reported that some 420 acres had been newly planted with this crop.

Fruit.—A disease of durian trees in Penang Island was investigated. Its symptoms were very similar to those of Patch Canker of the rubber tree and the fungus *Phytophthora palmivora* (*faberi*), responsible for the disease of rubber trees, was found in the bark of the durians.

It is reported from Singapore that fresh lime fruits exported to England reached their destination in good condition and commanded high prices on the home market.

Vegetables.—Good crops of gourds, maize and tapioca were ripening on the temporary bunds of grass in Krian padi areas. Some headmen in South Krian are trying vegetable growing on the dry padi land itself. In Malacca, Chinese were growing vegetables on the padi land near markets after reaping the padi crop.

In Pahang west, the planting of food crops such as maize, tapioca and yams was in progress. This is becoming a regular annual practice just before the commencement of padi planting and is popular because it helps the peasants to supplement their food supply until the following padi harvest. The land used is not padi land and is generally held under temporary occupation licence.

Tobacco.—Prices for sun-dried tobacco leaves have ranged from $10 to $56 per picul according to quality in most parts of the country. In Malacca, a rise in price to about $55 per picul has led to renewed planting by Chinese on padi land. In Johore, interest in the crop has been well maintained with prices ranging from $30 to $80 per picul. In Singapore Island, prices have risen but supplies of leaf were scarce owing to successive floods in the chief tobacco growing areas.

Agricultural Stations.

Favourable weather conditions enabled progress to be made with planting programmes at all Stations, both in respect of permanent and annual crops.

The first stage of an experiment on the manuring of annual crops was concluded at the Selama Agricultural Station where it was found that plots on which a leguminous green manure had been turned in gave much better yields of gingelly than did those treated with non-legumes or grass. A parallel experiment at the Rembau Station gave very poor yields throughout.

An experiment on the manuring of ginger and turmeric was laid down at Selama, Cheras and Sungei Udang Stations.

At the Pineapple Experiment Station in Singapore a number of selected pineapple plants were planted out in rows from selections made at the Station itself and on an estate in the Island. Seeds from a number of selected pineapples were sown in the Solar propagator and some commenced to germinate. Tobacco planted early in the month was almost a complete failure owing to heavy rain.

Six more Light Sussex pullets were received from England at the Sungei Udang Station and six local hens for cross breeding with the White Wyandottes were obtained for the Pineapple Station in Singapore. Yields of eggs at the Tanah Rata Experiment Station from the pure bred imported fowls continued to be satisfactory; the six Rhode Island Red pullets gave 123 eggs, each weighing over 2 ozs., during the month.

Padi Stations and Test Plots.

With three exceptions, harvest was finished, or almost finished, on all Padi Test Stations and Plots at the end of the month.

Results from the majority of the Stations and Plots were under examination in the Head Office. Siam 29 has again shown itself a high-yielding strain readily adaptable to conditions in many different parts of the country, in all of which it has done well. Its main defect is a rather weak straw. Mayang Ebos 203 has also done well at several of the northern Stations and Plots.

Work for the coming season has already been commenced on the two inland Test Plots in Selangor, the Jelebu Plot in Negri Sembilan and the Temerloh Plot in Pahang.

On the Kuang Plot in Selangor, the short term varieties of padi, planted between seasons, were ripening, but much of the grain was empty owing to damage by birds and possibly to unfavourable weather conditions.

Vegetable beds have been prepared and planted for inter-season trials on Bukit Merah Test Station in Province Wellesley and Kendong Padi Test Plot in Negri Sembilan.

A small supply of mushrooms was obtained from the bed of padi straw established at the Sungei Udang Test Plot adjoining the Agricultural Station in Malacca.

Rural Lecture Caravan.

The Caravan visited Kuala Langat District of Selangor from March 6th. to 15th., when lectures illustrated by lantern slides, models, photographs and specimens were given on poultry husbandry, the preparation of improved copra and coffee.

From March 16th. to 25th., five centres in the Seremban District of Negri Sembilan were visited, the subjects dealt with being poultry husbandry and treatment of mouldy rot disease of rubber.

Malayan Padi Competition.

Local competitions were held at 16 centres in Negri Sembilan during the month, the total entries aggregating 776. From among these, a limited number were selected for forwarding to the Malayan Exhibition to be held in Kuala Lumpur at the beginning of June. Exhibits from the large padi-growing area in Rembau sub-District were disappointing both in numbers and in quality. Exhibits at each centre were criticised, owners were informed of faults and the exhibition standards were explained.

DEPARTMENTAL NOTES.

Retirement of Dr. Jack.

Dr. H. W. Jack, Economic Botanist, has been granted full-pay leave for 3 months, 25 days from 31st March to 25th July, 1934, on abolition of office.

Dr. Jack joined this Department in May 1914, as Assistant Agricultural Inspector. In the following year he was transferred to instructional activities and in 1919 was appointed Economic Botanist.

His activities in the Department have been concerned with a number of crops, but his research work on padi is the best known and attracted attention beyond the confines of this country. His services in this direction received recognition by the confirment on him in 1930 of Membership of the Order of the British Empire.

His reputation on the field of sport is no less well known, both locally and in Europe. On two occasions he was a member of the Irish International Rugby football team and was for many years a prominent member of the Selangor Rugby team.

Dr. Jack will, in July, assume duty as Director of Agriculture, Fiji. His colleagues in this Department wish him every success in his new appointment.

Rural Lecture Caravan.

Experience gained in the past led to the suggestion that tours of the Rural Lecture Caravan would be more effective in conveying instruction if the Caravan were to remain in each centre visited for two days instead of one. In order to give in one day both a display of films teaching general lessons and lectures conveying more detailed information on special subjects, it was necessary to commence the lectures at about 4.30 in the afternoon, then to make a break of about two hours and commence displaying the films at 7.30 p.m. There were two main objections to this procedure. The time for the lectures and the break in the programme were found to be inconvenient to the audience, and the programme itself was so long that it was difficult to assimilate.

Consequently, it was decided to try the effect of spreading the programme over two days in each centre, the films being displayed on the first evening after dark, and lectures illustrated by models and lantern slides being given on the second evening. It was further decided to confine the lectures to not more than two subjects, each occupying about 20 minutes, and to allow an interval after each lecture for discussion and for examination of models and exhibits. The tables on which the latter were displayed were provided with electric lights supplied from the generator which could be switched over to the film projector or the lantern when the lights were not required.

A trial tour conducted in Kuala Selangor on these lines at the end of 1933 proved successful. In consequecne, this procedure has been adopted for all tours during the present year.

The agricultural subjects on which attention is mainly being concentrated are Poultry Husbandry, Preparation of Improved Copra, and Potential Money Crops for Small Holders. Three lectures on Poultry Husbandry have been prepared. These deal with housing, management of birds and feeding and sanitation. They are illustrated by means of models of houses and pens, protected feeding troughs and drinking troughs, all made of materials readily available to dwellers in the villages.

The lecture on the Preparation of Improved Copra gives details of the construction of a good type of simple kiln and of its correct use. Models of good and bad kilns are provided and also a set of lantern slides.

Money crops for small holders include such crops as tobacco, groundnuts, gingelly and fruit trees such as the Brazil nut and the avocado pear. Each of these is dealt with quite shortly and in a general manner, with photographs and specimens as illustrations, the object being to draw the attention of the audience to the possibilities of each, leaving details of planting and cultivation to be given to those interested by the local Agricultural Officers in the course of their regular duties.

Copra Investigations.

A separate Division of the Research Branch of the Department has been created to deal with Copra investigations. The Division will be under Mr. F. C. Cooke, A.R.C.S., B.SC., A.M.I. CHEM. E., Assistant Chemist for Copra Investigations, whose title in future will be styled Officer-in-Charge, Copra Investigations.

The reorganisation will date from 1st. May, 1934.

Leave.

Mr. W. N. C. Belgrave, Chief Research Officer, returned from leave on 4th. March, 1934.

Mr. G. H. Corbett, Government Entomologist, returned from leave on 29th. March, 1934.

Statistical.

MARKET PRICES.

March 1934.

Rubber.—The market price of rubber fluctuated during the month, opening at 16¼ cents per lb. for Spot loose in Singapore and closing at 17 cents per lb. The highest quotation was on the 16th of the month when the price reached 18⅜ cents per lb. The average price for the month was 17⅛ cents per lb. in Singapore, 5⅛ pence in London and 10⅞ cents gold in New York, as compared with 16¼ cents, 4⅞ pence and 10¼ cents gold respectively in February.

Weekly prices during March for small-holders' rubber at Kuala Pilah, Negri Sembilan; Kuala Kangsar, Perak, and Batu Pahat, Johore, were as shewn in the following table:—

Grades	VALUE PER PICUL (dollars)								
	Kuala Pilah, Negri Sembilan.		Kuala Kangsar, Perak.			Batu Pahat Johore.			
	1.3.34	15.3.34	7.3.34	21.3.34	28.3.34	7.3.34	14.3.34	21.3.34	28.3.34
Smoked sheet	19.73					19.23	21.80	20.47	20.30
Unsmoked sheet	19.05	20.32						18.00	19.30
Rubber*			16.16	18.87	16.74				
Scrap		5.97							

* Wet unsmoked sheet.

Transport by lorry Kuala Pilah to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8.00 per ton.

Transport from Batu Pahat to Singapore by lorry excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

Transport from Kuala Kangsar to Singapore by railway $10.00 per ton (minimum consignment 5 tons).

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

At Kuala Kangsar the standard deduction for moisture in unsmoked sheet is 10 per cent.

Palm Oil.—The course of the market Liverpool/Continent during March on a basis of 5 per cent. f.f.a., c.i.f. was as follows: March 7th. £14.10.0 per ton net, March 14th. £13.15.0 per ton net, March 21st. £13.10.0 per ton net, and March 28th. £13.10.0 per ton net.

Prices in the U.S.A. landed weight per pound in bulk c.i.f. New York/Philadelphia were 2.75 cents gold on the 7th March, 2.62 cents gold on the 14th. March, 2.60 cents gold on the 21st. March, and 2.55 cents gold on the 28th. March.

The price of palm kernels Fair Average Malayan Quality c.i.f. landed weight on the Continent was shillings 7 per cwt. on March 7th., shillings 6/9 per cwt. on March 14th., shillings 6/6 per cwt. on March 21st., and shillings 6/3 per cwt. on March 28th.

Copra.—The price of copra fell during March. The highest Singapore price for Sundried during the month was $3 per picul, and the lowest price $2.65 per picul, the average price being $2.90 per picul as compared with $3 during February. The mixed quality averaged $2.31 per picul as compared with $2.40 per picul in February.

Coffee.—The price at Singapore for Sourabaya coffee remained fairly steady; prices ranged according to grade, from $20.75 to $21.50 per picul. Palembang coffee averaged $16.20 per picul during the month, being quoted at $16.75 per picul on the 2nd. and $16 per picul on the 30th. of the month; the average figure for February was $17.19 per picul.

Arecanuts.—There were no sales of Palembangs, Bila Whole or Kelantan in February, there being no stocks on the market. The range of Singapore prices for other grades were, Splits $7 to $11.50 per picul; Red Whole $2.30 to $5.90 per picul and Sliced $2.75 to $4.25 per picul.

Rice.—The average wholesale price of Siam No. 2 ordinary rice per picul in Singapore in February was $3.06, as compared with $2.91 in January. No. 1 Rangoon rice averaged $2.50 per picul in February as compared with $2.72 in January. Saigon No. 1 (long grain) averaged $2.60 per picul in February as compared with $2.65 per picul in January.

Tea.—During February, the average price quoted in London for Malayan tea was shillings 1/0.87 per lb. Average prices during February for tea consignments from other countries were as follows:—Ceylon shillings 1/3.75 per lb., Java shillings 1/0.71 per lb., Indian Northern, shillings 1/2.75 per lb. and Indian Southern, shillings 1/2.76 per lb.

Gambier.—The price of Block gambier remained steady during the month, averaging $4.19 per picul, Cube No. 1 averaged $6.69. Corresponding figures for February were $3.88 and $6.38 respectively.

Pineapples.—There was a slight fall in values during March, the average Singapore price per case being as follows:—Cubes $3.12, Sliced Flat $2.98 and Sliced Tall $3.06, as compared with $3.24, $3.06 and $3.19 respectively during February.

Tapioca.—The price of Flake Fair averaged $4.70 per picul as compared with $5.11 per picul in February. Pearl Seed averaged $5.80 per picul and Pearl Medium $6.38 per picul, both prices being similar to the average prices during February, namely $5.88 and $6.38 respectively.

Sago.—Pearl-Small Fair decreased slightly in price during March, averaging $3.65 per picul for the month; the average price was $3.76 per picul in February. Flour-Sarawak Fair averaged $1.87½ per picul as compared with the February average of $1.95 per picul.

Mace.—Prices were nominal during March, the average for the month for Siouw being $65 per picul, and for Amboina $40 per picul.

Nutmegs.—110's averaged in price during March $24.25 per picul, as compared with $21.25 per picul in February; 80's also increased in value, averaging $26.75 per picul against the figure of $24.25 per picul in February.

Pepper.—Average Singapore prices during March were as follows:—Singapore Black $15.69 per picul; Singapore White $29.88 per picul and Muntok White $30.75 per picul; the corresponding figures for February were $15.50, $29.12 and $30.50 per picul respectively.

Cloves.—Prices continued steady and nominal as in the previous month; Zanzibar averaged $35 per picul and Amboina $45 per picul.

Tuba Root.—There was a scarcity of supplies during March, the prices being nominal and similar to last month's averages, namely $25 to $30.50 per picul.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports are kindly supplied by Messrs. Guthrie & Co., Ltd., Kuala Lumpur; the Singapore prices for coffee and arecanuts by the Lianqui Trading Company of Singapore, and tuba prices by Messrs. Mackay & Co., Singapore.

1 picul = 133 1/3 lbs. The Dollar is fixed at two shillings and four pence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Charing Cross, London, S.W.1.

GENERAL RICE SUMMARY.*

February 1934

Malaya.—Gross foreign imports of rice (including stocks available for re-export) during February 1934, amounted to 41,623 tons, as compared with 46,275 tons in February 1933, of which 40 per cent. were consigned to Singapore, 24 per cent. to Penang, 7 per cent. to Malacca, 27 per cent. to the Federated Malay States and 2 per cent. to the Unfederated Malay States.

Of these imports, 57 per cent. were from Siam, 39 per cent. from Burma, 3 per cent. from Indo-China and 1 per cent. from other countries.

Total foreign exports of rice from Malaya in February 1934 were 9,576 tons (including 174 tons local production) as compared with 13,975 tons in February 1933.

Of these exports 68 per cent. were consigned to Netherlands India and 32 per cent. to other countries.

Net imports for the period January to February 1934, were 66,902 tons as compared with 67,152 tons during the same period for 1933, a fall of .4 per cent.

India and Burma.—Total foreign exports of rice during January 1934, were 77,000 tons as compared with 74.000 tons in December 1933 and 68,000 tons in January 1933, an increase of 4 per cent. in respect of the previous month and an increase of 13 per cent. in respect of the same period in the previous year.

The total area under rice (1933-1934) as reported in the Indian Trade Journal dated 1st March, 1934, was 81,977,000 acres as compared with 82,661,000 acres in the previous year, a decrease of .8 per cent. The total yield is estimated at 30,353,000 tons of cleaned rice as compared with 31,089,000 in 1932-1933, a decrease of 2.4 per cent.

Japan.—The production of rice in Japan (Proper) during 1933 amounted to 9,936,484 tons as compared with 8,469,859 tons the previous year or an increase of 17.3 per cent. The increase is due to considerable improvement of agricultural technique and continued favourable weather conditions.

The balance of stock of rice in Japan (Proper) on October 31st, 1934, after deducting requirements for export and consumption is estimated at 2,637,700 tons.

Imports of Korean and Formosan rice into Japan (Proper) were:

		1st Nov. 1933 to 20th Jan. 1934 tons.	1st Nov. 1932 to 20th Jan. 1933 tons.
Korea	...	338,429	385,835
Formosa	...	149,509	198,036

* Abridged from the Rice Summary for February 1934, compiled by the Department of Statistics, S.S. and F.M.S.

Siam.—Exports of rice from Bangkok (approximate) during February 1934, amounted to 140,961 tons as compared with 144,428 tons in February 1933, a decrease of 2 per cent.

According to the Second Forecast (1933-1934) the area planted at the end of December 1933, amounted to 7,638,000 acres as compared with 7,576,000 acres the previous year, an increase of .8 per cent. The total outturn is estimated at 2,969,000 tons of rice and the surplus available for export at 1,346,000 tons.

Note: The figures for 1934, are approximate.

Netherlands India, Java and Madura.—No further information to that published in the Summary for the month of December, 1933, is available.

French Indo-China.—Exports of rice from Saigon for the period January and February 1934, totalled 206,000 tons, an increase of 18,000 tons or 9.6 per cent. as compared with the corresponding period of 1933.

Ceylon.—Imports for the month of January 1934, totalled 44,939 tons, an increase of 8,527 tons on the imports for the same perood of 1933.

Of these imports 16 per cent. were from British India, 67 per cent. from Burma and 17 per cent. from other countries.

Europe and America:—Quantities of rice shipped from the East were:—

(*a*) To Europe for the period January 1st to February 15th 1934, 57,401 tons, a fall of 67,570 tons or 54 per cent. as compared with the same period of 1933. Of these shipments, 11 per cent. were from Burma, nil from Japan, 74 per cent. from Saigon, 12 per cent. from Siam and 3 per cent. from Bengal, as compared with 30 per cent. from Burma, 13 per cent. from Japan, 50 per cent. from Saigon, 6 per cent. from Siam and 1 per cent. from Bengal in 1933.

(*b*) To the Levant, period January 1st to January 17th 1934, 123 tons an increase of 87 tons or 242 per cent. as compared with the same period of 1933.

(*c*) To America and the West Indies for the period January 1st to January 22nd 1934, 49 tons an increase of 49 per cent. as compared with the same period of 1933.

MALAYAN AGRICULTURAL EXPORTS, FEBRUARY, 1934.

PRODUCT.	Net Export in Tons.				
	Year 1933.	Jan.-Feb. 1933.	Jan.-Feb. 1934.	February 1933.	February 1934.
Arecanuts ...	20,756	4,533	7,444	2,126	3,832
Coconuts, fresh ...	100,609†	16,154†	14,544†	9,139†	8,029†
Coconut oil ...	17,568	2,960	3,867	1,342	2,104
Copra ...	110,543	18,991	17,054	4,407	7,791
Gambier, all kinds ...	2,560	394	328	213	155
Palm kernels ...	1,983	199	346	134	186
Palm oil ...	12,101	562	1,664	157	1,367
Pineapples canned ...	59,582	9,025	8,832	4,312	4,165
Rubber ...	459,836§	67,388§	83,605	31,559§	41,832
Sago,—flour ...	7,648	1,369	1,088	713	437*
„ —pearl ...	2,646	348	475	219	220
„ —raw ...	4,420*	767*	768*	272*	304*
Tapioca,—flake ...	9,881	1,915	1,179	965	530
„ —flour ...	702*	364	213§	49	29*
„ —pearl ...	17,297	2,418	2,333	1,362	1,234
Tuba root ...	569½	43	106½	39	62

† hundreds in number. * net imports. § production.

NETHERLANDS INDIA RUBBER STATISTICS.

Acreage of Tappable Rubber not tapped at the end of January, 1934.

January 1934	A		B		C	
	Totally ceased		Partly ceased		Total A & B	
	Number of Estates	Area in Acres	Number of Estates	Area in Acres	Number of Estates	Area in Acres
Java ...	65	21,044	73	20,516	138	41,560
Outer Provinces ...	176	52,236	82	51,781	258	104,017
Netherlands India ...	241	73,280	155	72,297	396	145,577

The above acreages are converted from hectares, at 2.47 acres.

The total area out of tapping for January, 1934, amounts to 14.9 per cent. of the total tappable area at end of December, 1932.

ACREAGES OF TAPPABLE RUBBER NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING FEBRUARY, 1934.

STATE OR TERRITORY	Acreage of Tappable Rubber end 1932 (*d*)	ESTATES WHICH HAVE ENTIRELY CEASED TAPPING		ESTATES WHICH HAVE PARTLY CEASED TAPPING		AREA OF TAPPABLE RUBBER NEVER BEEN TAPPED		Total (3) + (5)	Percentage of (9) to (2)
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)	Acreage	Percentage of (7) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
STRAITS SETTLEMENTS :—									
Province Wellesley	44,734	1,323	2.9	7,302	16.3	1,082	2.4	8,625	19.2
Dindings	6,,969	209	3.0	865	12.4	546	7.8	1,074	15.4
Malacca	111,780	4,740	4.2	15,933	14.2	7,316	6.5	20,673	18.4
Penang Island	1,635	365	22.3	82	5.0	170	10.4	447	27.3
Singapore Island	28,269	8,021	28.3	4,743	16.8	248	0.9	12,764	45.1
Total S.S. ...	193,387	14,658	7.6	28,925	14.9	9,362	4.8	43,583	22.5
FEDERATED MALAY STATES :—									
Perak	250,951	3,991	1.6	27,715	11.1	14,225	5.7	31,706	12.6
Selangor	308,379	1,924	.6	36,479	11.8	12,564	4.1	38,403	12.4
Negri Sembilan	228,541	5,125	2.2	21,430	9.4	15,976	7.0	26,555	11.6
Pahang	38,141	5,227	13.7	5,207	13.6	5,086	13.3	10,434	27.3
Total F.M.S. ...	826,012	16,267	1.9	90,831	11.0	47,851	5.8	107,098	12.9
UNFEDERATED MALAY STATES :—									
Johore	325,747	20,794	6.4	32,442	10.0	21,470	6.6	53,236	16.3
Kedah (*a*) (*b*)	126,588	3,595	2.8	9,556	7.6	(*e*) 5,700	4.5	13,151	10.3
Kelantan	21,175	5,749	27.1	2,200	10.4	1,860	8.8	7,949	37.5
Trengganu (*c*)	4,395	Nil	Nil	1,561	35.5	Nil	Nil	1,561	35.5
Perlis (*a*) (*b*)	957	106	11.1	131	13.7	308	32.2	237	24.8
Total U.M.S. ...	478,862	30,244	6.3	45,890	9.6	29,338	6.1	76,134	15.9
TOTAL MALAYA ...	1,498,261	61,619	4.1	165,646	11.0	86,551	5.8	226,815	15.1

Notes :—(*a*) Registered companies only and are rendered quarterly.

(*b*) The figures quoted for Kedah and Perlis are those for end December 1933, and Kelantan end January, 1934 Revised figures will be published when available.

(*c*) Registered Companies only.

(*d*) Figures for end December 1933, are not yet available.

(*e*) Estimated : figures not yet available.

MALAYA RUBBER STATISTICS — TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF FEBRUARY 1934 IN DRY TONS.

Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month		
								during the month		January and February 1934		during the month		January and February 1934				
	Ports	Dealers	Estates of 100 acres and over	during the month	January and Feb. 1934	during the month	January and Feb. 1934	Foreign	From Malay States & Labuan	Foreign	From Malay States & Labuan	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
MALAY STATES :—																		
Federated Malay States ...	...	12,267	12,309	11,163	23,504	11,175	20,938	Nil	Nil	Nil	Nil	17,384	2,680	31,831	11,189	...	15,490	11,345
Johore ...	...	3,362	3,024	4,029	7,273	5,168	9,731	Nil	4	Nil	10	1,399	6,959	3,209	13,063	...	3,935	3,294
Kedah ...	...	406	2,487	2,766	5,892	1,632	3,599	Nil	Nil	Nil	Nil	1,668	2,887	2,899	6,688	...	384	2,352
Perlis ...	...	24	9	8	29	34	68	Nil	Nil	Nil	Nil	Nil	38	Nil	103	...	22	15
Kelantan ...	...	393	195	294	484	749	1,684	13	Nil	121	Nil	92	909	146	1,918	...	382	261
Trengganu ...	...	55	50	198	398	98	197	Nil	Nil	Nil	Nil	Nil	296	Nil	595	..	55	50
Total Malay States	...	16,507	18,074	18,458	37,580	18,856	36,217	13	4	121	10	20,543	13,769	38,085	33,556	...	20,268	17,317
STRAITS SETTLEMENTS :-																		
Malacca ...	...	2,649	1,220	1,376	2,698	2,325	5,372	Nil	16,198	1	33,280	3,284	Nil	7,522	Nil	...	3,427	1,182
Province Wellesley	...	1,029	692	525	1,155			Nil		Nil						...	926	543
Dindings ...	...	70	139	104	219			Nil		Nil		8,913		17,046		...	58	152
Penang ...	2,939	6,536	13	9	29			1,742		3,677						3,116	5,877	9
Singapore ...	6,159	32,045	143	179	335			13,074		27,158		25,127		50,269		4,961	34,215	159
Total Straits Settlements	9,098	42,329	2,207	2,193	4,436	2,325	5,372	14,816	16,198	30,836	33,280	37,324	Nil	74,837	Nil	8,077	44,503	2,045
TOTAL MALAYA	9,098	58,836	20,281	20,651	42,016	21,181	41,589	14,829	16,202	30,957	33,290	57,867	13,769	112,922	33,556	8,077	64,771	19,362

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Kedah
20	21	22	23	24	25	26
DRY RUBBER	11,625	29,396	4,912	3,626	1,733	115
WET RUBBER	3,865	4,819	965	785	2,202	269
TOTAL ...	15,490	34,215	5,877	4,411	3,935	384

TABLE III
FOREIGN EXPORTS

PORTS	For month	January and Feb. 1934
Singapore ...	35,097	71,619
Penang ...	14,570	26,756
Port Swettenham.	7,479	13,030
Malacca ...	721	1,517
MALAYA ...	57,867	112,922

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	January and Feb. 1934
Malay States ... / Straits Settlements	42,389	82,496
MALAYA ...	42,389	82,466

Notes :—1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.

2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + 15 tons local consumption during the month — [2] — [3] — [4] — [5] — [9] — [10]. For the Straits Settlements, Columns [9] and [10] represent purchases by dealers from local estates of less than 100 acres, reduced by 15 % to terms of dry rubber.

3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15%; wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.

4. Domestic exports are estimated by deducting the average monthly dry weight of foreign imports over a period of 2 months from the gross foreign exports of the later month, the foreign exports of the Malay States being domestic production.

5 The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S. and F.M.S., at Singapore on 23rd March 1934.

METEOROLOGICAL SUMMARY, MALAYA, FEBRUARY, 1934.

Locality	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation, .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.								
Railway Hill, Kuala Lumpur, Selangor ...	91.1	70.9	81.0	95	68	85	72	83.3	83.8	8.84	224.5	3.27	14	12	1	1		152.65	5.45	45
Bukit Jeram, Selangor ...	88.2	71.7	79.9	91	70	81	73	85.3	85.5	0.38	9.7	0.23	6	2				162.55	5.80	48
Sitiawan, Perak ...	87.6	71.0	79.3	91	68	79	74	82.7	83.5	4.49	114.1	1.18	12	10	1			175.40	6.26	52
Temerloh, Pahang ...	85.5	70.9	78.2	91	68	74	73	81.3	83.1	1.94	49.3	0.51	9	8				128.40	4.59	38
Kuala Lipis, Pahang ...	84.4	69.8	77.1	90	67	72	72	80.9	82.0	6.17	156.7	1.50	16	14	2	15		107.75	3.85	32
Kuala Pahang, Pahang ...	82.1	73.3	77.7	86	67	76	77	80.5	81.5	8.93	226.8	3.69	13	11				131.40	4.69	39
Mount Faber, Singapore ...	84.7	70.8	77.7	89	69	73	73	78.7	79.3	6.07	154.2	1.90	15	13	3	1		157.80	5.64	47
Butterworth, Province Wellesley ...	86.6	71.8	79.2	91	69	79	75	83.1	84.2	2.14	54.4	0.68	10	7				181.95	6.50	55
Bukit China. Malacca ...	85.8	72.0	78.9	90	69	81	74	81.2	81.6	3.79	96.3	3.05	7	7	1			171.10	6.11	50
Kluang, Johore ...	85.1	70.3	77.7	91	66	73	72	78.3	79.2	7.97	202.5	2.17	14	13	1	2		154.60	5.52	46
Bukit Lalang, Mersing, Johore	81.3	71.5	76.4	85	67	75	75	77.6	78.3	9.57	243.1	3.74	14	10	1					
Alor Star, Kedah ...	88.6	69.6	79.1	93	64	81	73	81.7	83.3	1.41	35.8	0.68	7	6	4	2		169.85	6.07	51
Kota Bahru, Kelantan ...	83.6	70.9	77.3	89	65	77	74	79.5	81.4	6.70	170.2	2.11	16	10				142.00	5.07	43
Kuala Trengganu, Trengganu	82.9	70.6	76.7	87	65	77	74	79.4	80.4	5.80	147.8	1.30	14	10	1			143.80	5.14	43
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft. Pahang ...	69.7	59.9	64.8	80	58	62	63	69.0	69.4	4.27	108.5	0.80	19	15	5	15		78.25	2.79	23
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	70.3	55.1	62.7	73	46	64	61	67.5	68.3	6.19	157.2	2.52	12	9		2	1	105.85	3.78	31
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ..	69.9	57.3	63.6	74	53	63	60			6.43	163.3	3.24	11	10		1	1	107.40	3.84	32

Compiled from Returns supplied by the Meteorological Branch, Malaya